1990s INTRODUCTION

THE DAWN OF THE INFORMATION AGE

Darryl Smith

The political, social, physical, and educational worlds are not mutually exclusive; they coexist and affect each other, sometimes in reactionary ways. The launching of the Soviet Union's and the world's first artificial *Sputnik* satellite on October 4, 1957, is a case in point. It showed that North America was lagging behind the Soviets in the space race and triggered the "New Math" movement of the 1960s with its emphasis on mathematical structure, set theory, and number bases other than 10. Can you imagine what our world of mathematics would be like if humans were all born with, say, four digits on each limb? Surely we wouldn't have a base-8 number system!

It seems to me that often mathematics education is trying to catch up to unfolding world events. We are all familiar with the question about what came first—the chicken or the egg? However, what if the question was, "What came first—science or mathematics"? In the early 19th century, the famous German mathematician Carl Friedrich Gauss referred to mathematics as the "queen of the sciences." Historically, mathematics has been successful at uncovering and explaining the nature of physical reality; the symbiotic successes of mathematics and science continued into the 1990s.

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Many consider the 1990s to be the dawn of the information age. That decade saw the beginning of widespread use of the internet by the public, DOS-based computers had evolved to Microsoft's Windows 3, and the MacPlus of 1986 was replaced by the MacClassic and the MacII. The original Intel Pentium processor was introduced in 1993, and Windows 95 and 98 arrived, along with the Apple iMac. In 1999, the Apple PowerMac G4 boasted in excess of one billion floating point operations per second!

In 1994, Sir Andrew Wiles, a Royal Society research professor at Cambridge University, proved a theorem that had been postulated circa1665 by Pierre de Fermat. Fermat's Last Theorem, which states that $x^n + y^n = z^n$ has no integer solutions for $n > 2$ and $x, y, z \neq 0$, has the distinction of being the theorem with the largest number of publisbed false "proofs," since in excess of 1,000 were published between 1908 and 1912. In 1998, Sir Wiles received a silver plaque from the International Mathematical Union in place of the Fields Medal to recognize his achievements (the Fields Medal is restricted to those under 40 and Sir Wiles was 41 at the time of his discovery). Sir Wiles has an asteroid (9999 Wiles) named after him, and he was appointed Knight Commander of the Order of the British Empire in 2000.

In science and space exploration, the Galileo probe was launched on October 18, 1989, and inserted into orbit around Jupiter on December 8, 1995. The Human Genome Project began in 1990, a year that also saw the launching of the Hubble Space Telescope (now proposed to be in service until 2014). In 1992, the first Canadian woman in space, Dr. Roberta Bondar, flew aboard NASA's space shuttle Discovery. The Pathfinder mission to Mars was launched on December 4, 1996, and landed on the Martian surface on July 4, 1997. The existence of extra-solar planets was discovered, Dolly the sheep was cloned, genetically engineered crops were invented, GPS became fully operational, and HIV/AIDS mortality was reduced through the use of highly active anti-retroviral therapy (HAART).

In my opinion, the most exciting development in mathematics education during the 1990s was the introduction of the graphing calculator. Casio marketed its fx-7000G in 1985; Texas Instruments introduced its Ti-81 in 1990, followed by many others in the TI-family. There were brief stints with Casio, Hewlett-Packard, and Sharp, but Texas Instruments emerged as the leader in mathematics education. Paired with an overhead palette and perhaps a CBL Ranger, the graphing calculator became a teaching tool of the highest order. The graphing calculator not only did away with the tedium of calculation; it allowed more time to spend on the mathematics of a situation. More importantly, students used the graphing calculator to explore and even discover mathematics. Established programs such as advanced placement and international baccalaureate both shifted their objectives to require the use of a grapbing calculator in some sections of their examinations.

The calculus reform that was initiated in the 1990s emphasized that a particular problem could be solved numerically, algebraically, or graphically (the Rule of Three), and that these seemingly disparate techniques were actually complementary. This in turn facilitated more communication among students of mathematics and other fields in the physical and social sciences. The modern calculus texts of the 1990s, complete with excellent multicolour graphics and calculator and computer screenshots, saw the inclusion of more real-world and nonstandard problems, which, in turn, increased the demand for more conceptual understanding. Students seemed to take a great deal of interest in, for instance, related rate or max/min problems that had their origins in the fields of medicine and physiology.

Specialized examinations and surveys such as the Trends in International Mathematics and Science Study (TIMMS), initiated in 1995 by the International Association for the Evaluation of Educational Achievement (IEA), compared student proficiency in mathematics and science among participating countries throughout the world at the grades 4 and 8 levels. The summary report dated September, 2000, claims that "Canadian (grade 8) students performed relatively well in mathematics and science!" It goes on to state that only six countries had achievement results that were "significantly higher" than those of Canada in mathematics, and only five countries were "significantly higher" in science. The Program for International Student Assessment (PISA) Study began in 2000 and compares 15-year-old students in reading, mathematics, and science; Canada scored near or at the top in all three disciplines when compared to G8 countries. In mathematics, only 11 percent of Canadians scored below Level 2 (the best result among G8 countries), and 18 percent of Canadians scored above Level 4 (second only to Japan).

In a paper entitled *The Canadian Mathematics Curriculum from New Math to the NCTM Standards,*[1] Dr. Thomas O'Shea of British Columbia's Simon Fraser University puts the 1990s in perspective by reflecting that changes in Canadian mathematics curricula paralleled curriculum movements worldwide. According to Dr. O'Shea, Canadians experienced the euphoria of the "New Math," and that period was followed by a back-to-basics movement. The National Council of Teachers of Mathematics (NCTM) *Agenda for Action* of the 1980s made problem solving central to the mathematics curriculum of that decade, and the NCTM Standards shaped the curriculum of the 1990s. Dr. O'Shea characterized Canadian curriculum swings in education as "muted," saying that they occurred later in Canada then they did in the United States, ostensibly because of the provincially based educational decision making process of those years. The ministers of education of the western provinces (British Columbia, Alberta, Saskatchewan, and Manitoba) as well as the Northwest and Yukon Territories signed the Western Canadian Protocol for Collaboration in Basic Education (WCP) in December of 1993

(Nunavut joined in 2000). The WCP saw the development of common curriculum frameworks with learning outcomes in language arts, mathematics, and international language; the first common curriculum framework in mathematics (K–9) was released in both official languages in June, 1995. I believe that the agreements made in the WCP were a major development in mathematics education.

During the 1990s, mathematics education experienced significant change not only in Alberta schools, but across Canada and North America. This change was due not only to the implementation of technologies such as graphing calculators and computers in classrooms, but also to the publication of vastly improved textbooks. Perhaps, however, even more important was the most enjoyable trend towards collegiality and communication that developed among mathematics educators in the 1990s; educators were more than willing to share exercises, exams, teaching ideas, and knowledge on a large scale, thanks in part to the internet. Mathematics conferences, item writing, and marking sessions as well as august groups such as the Mathematics Council of the Alberta Teachers' Association (MCATA) and various mathematics learning consortia throughout the province all had many positive effects on mathematics education in Alberta that continue to be enjoyed to the present day.

NOTE

1. O'Shea, Thomas, Simon Fraser University, "The Canadian Mathematics Curriculum from New Math to the NCTM Standards." Excerpts from the third draft of Chapter 18 of the NCTM's Mathematics History Volume, 2003, http://cms.math.ca/Events/CSMF2003/panel/oshea.pdf

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Darryl Smith retired in 2002 after having taught for 34 years with Edmonton Catholic, 30 of which were spent at Austin O'Brien High School. Since his retirement, he has continued to tutor many students in mathematics, and that role has required him to keep abreast of curriculum developments. He looks forward to many more years of mathematics education.